Vol. 1—2 Tie up as it is V. 1 Lacks #1

PAVING AND MUNICIPAL ENGINEERING.

A Journal Devoted Specially to Street and Sidewalk Paving, Water Works Construction, Bridge Building, Street Lighting, Sewerage and all Matters Pertaining to Public Improvement in Cities.

ONE DOLLAR A YEAR IN ADVANCE. INDIANAPOLIS, IND., JULY, 1890. SINGLE COPIES, TEN CENTS.

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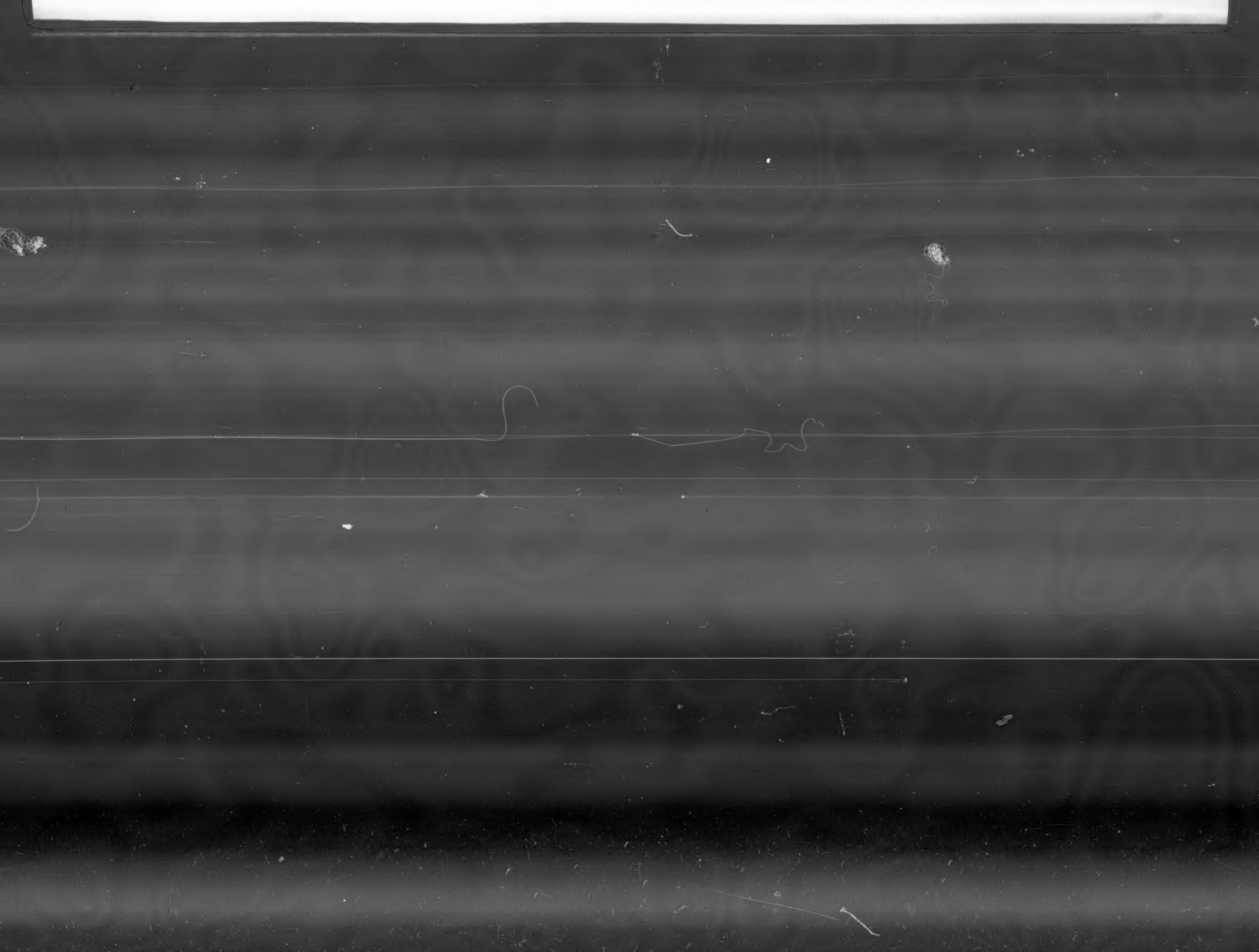

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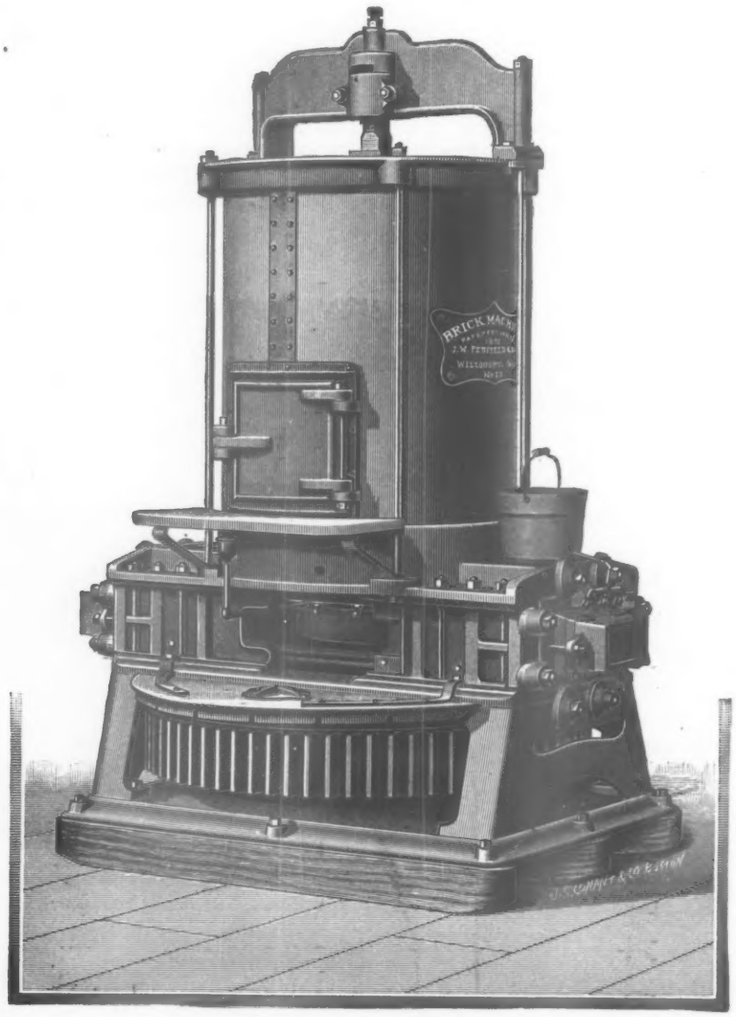

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PUBLIC FILTRATION—THE OLD AND THE NEW.

By John A. Caldwell.

UNTIL quite recently almost the only system of water filtration on a large scale was in open reservoirs having practically porous bottoms. The bottoms were composed of sand, gravel and stones, the water to be filtered flowed over the sand, passed down through and out at the bottom, or entered at the bottom, passing upward and out at the top. The coarser impurities lodged in the sand, and were washed out by a reversed current, or, in the case of downward filtration, were removed by paring off thin slices from the top portion of the sand at stated intervals, and at longer intervals removing the sand and washing it by hand. Where local conditions were favorable, deep cavities or trenches were dug alongside of the river or lake, the water percolating through the bar thus formed became a source of supply. Sometimes a couple of open walls were built across a corner or through the center of an impounding reservoir, some few feet apart, the space between filled with gravel or sand and the suction of the pump connected to one side only.

In all cases a mere straining of the water was aimed at. Of the first, England and the Continent present many perfect examples. Of the second, Los Angeles, Cal., Hamilton and Toronto, Ont., Nashville, Tenn., Lowell and Attleboro, Mass., Newark, N. J., and Providence, R. I., are examples. Of the third, Waterloo, N. Y., Litchfield, Ill., and I believe Springfield, Mass., have tried such plans. Of the above list, Los Angeles alone lays claim to success, the conditions at that point being peculiar. Of the first there are a few examples on this side, Poughkeepsie, N. Y., being the pioneer and best known. I find Stratford, Ont., has something; also St. Catherine, Ont, and Pawtucket, R. I. Until recently New Brighton, Pa., had a device of the kind.

Each of these systems has its advocates. Opinions on the subject are as varied as men's minds. Filtration in this country may be said to be in its infancy. It is on trial. No city adopts it without inquiry. This will doubtless be the case for some years to come. Although the responsibilities of making a choice have driven water boards and engineers to fall back on ancient precedent, this action has not been the means of saving them from failure at many places. One of the most conspicuous causes of failure has been the neglect to provide adequate means for washing the filter beds—in the case of beds—and keeping the bars free and open in cases where deep trenches were dug alongside of the river or lake supply. Many failures are reported from this cause, the most recent coming to our knowledge in the annual report of a large city, in which it is stated that the water within the trench, which, at the beginning of operations, was level with that in the river, was, at the end of one month, one foot lower; at the end of two months, five feet lower; at the end of the fifth month, no water passed through the bar, though the river remained the origina height.

Some few years ago a system, containing many novel features came into public use in this country. Its successful adaptation and introduction had fairly won for it the title of "The Modern System." To enumerate some of the radical changes this system involved, I mention:

First. The use of inclosed tanks, made of boiler plate, as against brick and stone receptacles.

Second. Filtration under pressure, as against open gravity filtration.

Third. Rapid filtration, through small areas of bed, as against slow filtration through large areas of bed, the difference being in some cases as high as forty to one.

Fourth. Daily washing of the bed within the tanks by means of the water pressure, as against periodical hand-scraping of the surface and removal of the beds by hand labor.

Finally. The use of a coagulant to curdle the impurities before filtration, after the fashion of nature.

The aggregate results of these changes may be briefly summed up as follows: A greatly improved filtration at much reduced cost.

The disadvantages and positive objections to the old system, sought to be overcome in the new, may be enumerated as follows:

First. The original cost of the large bodies of land necessary on which to place the filter plant, the same being in many cases near the city to be supplied and the land proportionally high in value.

Second. The cost of such large excavations, of the building material, labor, and the large amount of material before filtering.

Third. The comparatively large operating expenses, gangs of men being in constant attendance scraping the fouled surfaces and removing some portions of the bed unceasingly.

Finally. The objectionable quality of the resultant water from a sanitary point of view.

One of the best examples of the so-called filter beds is to be found in Leeds, England, while one of the best examples of the so-called modern system of water purification is to be found at Atlanta, Ga. To compare data from these two plants, one against the

other, is treating the subject with exact fairness. It is the weighing of both in the balance to see which is found wanting.

The first cost of the filter beds at Leeds was $30,000 per million gallons of water filtered daily. A recent published statement placed the first cost of the beds at Carlisle, England, at a higher figure, also those for the city of Liverpool, while the average first cost of the modern system is not more than $12,000 per million gallons of water filtered daily. The operating expenses at Leeds amount to $5 per million gallons, while those of a modern system are stated in the Annual Report, just published, to be $2,093.39, or $2.76 per million gallons filtered. Of this sum, $730 was for labor and $1,363 for coagulant, or 97 cents per million for labor and for coagulant $1.80 per million. The item of $730 means the labor of one man 365 days at $1.50 per day, and a boy at 50 cents a day for the same time.

These figures show the first cost of the modern system to be four-tenths the cost of the old filter beds, and the operating expenses to be little over one half. If a plant equal to that at Leeds were to be built in this country, the difference in the prices of labor and material would probably run the first cost up to $50,000 per 1,000,000 gallons filtered daily, and the operating expenses to $8.00 per 1,000,000, making the first cost of the modern system only one-quarter that of the old, and the operating expenses only about one-third. It should be remembered that in the modern system facilities are provided for partial subsidence before filtration, thus reducing the alum account. The average throughout the year just passed was six-tenths of a grain to the gallon of water filtered. There were times throughout the year when the quantity used was only one grain to three and one-quarter gallons of water filtered. At other times none at all, and at no time was the amount over ninety-two grains per 100 gallons.

More recent practice has reduced the alum account one-fourth, by using sulphate of alumina in the place of alum. The sulphate of alumina contains forty-eight to fifty-six, say fifty, per cent. of sulphate of alumina, which is the active agent, while commercial alum contains only thirty-eight per cent. The price of each is about the same, so there is a net saving of twenty-five per cent. Had sulphate of alumina been used during the year in the modern system, cost for coagulant would have been reduced from $1.80 per 1,000,000 gallons to $1.35 per 1,000,000, or $1,022 for the year.

It may be stated that the man in charge of the filter plant had other duties, and did not give his whole time to the filters; but allowing that he did, and that he was paid the wages he would get in England for the same work, we find the operating expenses of the modern system to be only, coagulant, $1,022; labor, $365; making a yearly total of $1,387, or $1.83 per 1,000,000 gallons filtered, or about one-third the cost of operating the old system if the plants were built side by side in this country by the same labor and costs of material.

So far I have said nothing about the quality of the resultant water.

In the old systems no attempt is made to do more than simply strain the water of the comparatively coarse impurities, while in the new system actual purification takes place, the water in some instances proving upon examination to be absolutely sterile. It will be admitted by the warmest advocates of the new system that slow filtration is more efficient than fast when no coagulant is used in either case, but it must be admitted, on the other hand, that by the addition of the coagulant, water may be filtered forty times faster than by the old system and be rendered very much purer. Let anyone who doubts this pass water through a modern filter forty times slower than the rated capacity of the filter and he will find that with a sand bed averaging double the depth of the old filter beds, the result will not compare with the fast filtration and a coagulant.

What is the action of coagulant? The sulphate of alumina of commerce contains 50 per cent. of sulphate alumina and a small percentage of water. The sulphate of alumina becomes a hydrate of alumina, a white gelatinous mass, which diffuses throughout the water much as a drop of red ink would tint a tumbler of clear water. Each individualized particle of this gelatinous mass becomes coated over with the matter within its reach, as one's clothes would become coated over with tufts of cotton in a cotton factory, the action being purely mechanical.

Matter that previous to coagulation was so fine as to go through the filter bed with ease becomes by force of circumstances part of a community of particles, the smallest of which communities is larger than the largest mesh or interstice of the filter bed, hence everything in suspension, after coagulation, is caught and held in the filter bed to be discharged with the daily washing. The importance of this adjunct to a filtering system will be apparent when we remember that some species of bacteria are no longer than 1-25,000 of an inch, and are capable of passing through porcelain tubes. The food that these bacteria exist upon must be smaller still, so it will be seen how hopeless must be the attempt to get pure water on a large scale without coagulation in the present state of the art.

The old filter-bed system invites another trouble which has not been touched upon, viz.: the necessity of exposing the water to the sun. Short-lived germs are rapidly developed—their death means putrefaction, also prolific growths of algæ are promoted on the sides of the inclosures and the surface of the sand. In warm climates like ours, these conditions are aggravated. Various gases of decomposition permeate the water and give rise to obnoxious odors and other impurities not eliminated by merely straining through the sand. To roof in large bodies of water is very expensive.

In the modern system the filter beds are not only covered over, but the filtering is done under pressure. The water is not exposed during any portion of the process, and passes to the mains the moment it is filtered. Finally, the water is rendered so completely free from impurities by means of the coagulation that it may be kept for months without apparent deterioration.

PAVEMENT CONSTRUCTION AND ECONOMICS.*

By Capt. D. Torrey.

I DO not remember to have seen a satisfactory definition of the word pavement. The courts have in one instance, I believe, decided that graveling a roadway is to pave it. With this opinion I disagree, as I think the universal idea, ever present in the mind of any one intelligently discussing the subject, is, that the conception of a pavement, is that of a constructed surface to a roadway. To construct anything is to select the material to be used, to shape the parts and to put them together so as to subserve the end in view. If this definition is correct, the graveling of a roadway is not paving it; while the macadmizing of it with selected material, broken to suitable size would be; also the planking of a roadway is to pave it.

A street ought to be paved for commercial reasons when the uses to which it is put can be conducted with economy of cost as great as the annual charge incurred by paving it. It ought to be paved from sentimental considerations when its unsanitary condition causes sickness, or when the pleasure of using it is felt to be a sufficient return for the expense.

The surface of any pavement, being the only part of it which is visible, presents those characteristics by which it is popularly estimated and approved; while more observant people, the critical, few in number, do not form their conclusions from a pavement's superficial appearance, but also take into account every detail of its construction and of the quality of every material used. And with this information they draw conclusions as to the durability, serviceability and desirability of a pavement.

The wagon roads of America will have cost, when improved, a larger sum than its railroads, and to-day, poor as they are, they have cost us and our ancestors more money than any kind of engineering outlay we have made except for railroads; with a possibility that the sum is now actually in excess of the vast expenditures which we have made to build the most magnificent system of transportation facilities and appliances in the world.

*An address delivered at the Street Paving Exposition held at Indianapolis.

The knowledge which has guided our engineers in building railroads scientifically, which, after all, is but one way of saying prudently, is in no wise different from that demanded for the construction of our best street pavements. We have seen the cost of railroad freight transportation cut down to about one-fifth of what it was twenty-five years ago, and we may easily experience a proportionate reduction in the cost of highway transportation, to the extent that we shall extend street improvements made in accordance with the best knowledge and practice known at this time.

The railroad and the street engineer alike avoid unnecessary grades; alike they secure easy traction by building a smooth surface; one with deep ballast and stiff metal rails; the other with a concrete foundation and a sheet surface. Neither can secure a good result without providing a durable, unyielding foundation, a matter that a competent engineer always demands, knowing full well that false economies in building it are sure to entail extravagant outlay for maintenance indefinitely thereafter. No single principle of engineering art is more fully established than is the need everywhere, and at all times, and for all kinds of construction, of a good foundation. To secure a really good surface to a pavement of either cedar blocks, brick, stone, or of anything else, a good foundation is the first requisite. And in selecting a pavement the first question is, whether "it is better economy to pay for a new pavement about every five to eight years, and in the meantime to suffer all the annoyances and expense of ruts and hollows and frequent repairs, or to pay more for a good pavement at the start, and possess that which is a credit to the city, a pleasure to the citizens, and a pavement that, taking reduced maintenance expenses into consideration, will cost less and be far more satisfactory."

As to the kind of foundation to be placed under street pavements there is but one best, and that is everywhere available; a hydraulic cement concrete. Every engineer approves it, all cities of the world—London, Paris, Berlin, Liverpool, Manchester—all use it, and all expedients of using cheaper substitutes wherever tried, all over the world, and by all constructors from the days of the Romans to the present time, have been more or less failures. A well made hydraulic cement concrete hardens until the mass is like a single stone of the size and form of the concrete as laid, and it hardens still more as time passes, until the chemical changes which confer its properties are completed. It is durable for unknown centuries, and when broken through from necessity, is easily repaired and restored to be just as good as if undisturbed.

From a sentimental point of view, I believe there rests upon us a moral obligation and duty to so construct our public works that the generations succeeding us shall see in their good honest construction the record we should make of being people governed by principles of integrity. Experience demonstrates that a foundation of six inches of such concrete will bear without injury or deterioration the traffic of any street, and the needs of economy in municipal public works can best be met by adopting, as some cities have done already, as part of the specification of any kind of pavement, the provision of hydraulic cement concrete foundation six inches thick.

Having presented an opinion regarding the best foundation for a street pavement, it is in order to speak of the wearing surface to be placed upon it. I shall divide surface materials so as to group them all in two classes, according as the constructed pavement has a surface of blocks or one in a monolithic sheet, as are the asphalt pavements. A sheet-pavement may be one of some twenty kinds of asphalt, concrete, etc. A block-pavement may be one of wood, brick or stone, and as there are not only these differences of material, but also within each of such groups a number of species, depending upon our recognition of still closer inspections, such as common brick, fire brick, asphaltic brick or sandstone, granite, trap, or other kind of stone block, I shall avoid entering upon differing conditions, preparations, etc., of such a multiplicity of materials, and speak in a general way of block-pavements and sheet-pavements, admitting at once that all I may say will not apply equally to each article, but will be true of them as a class.

Our life-long familiarity with block pavements, and particularly with bowlders, which is the most barbarous of them all, has dulled our readiness of perception of the manifold disadvantages of a broken street surface. If you will picture to yourselves the contrast in serviceability, durability and desirability of a railroad track as now built with long continuous rail surfaces, and of one built of short iron blocks, however well set, the very absurdity of the thing not being considered, and you can very well gauge the mistaken practice of providing blocks over which to pull the vehicles used on our streets. Surely if easy traction has such immense advantages in operating a railroad, it has proportionate advantages in street traffic.

An accepted determination of the resistance to traction on different pavements is as follows:

On hard rolled gravel	1-30	of the	load	at a	pace.		
" ordinary cobblestone,	1-8	"	"	"	"	"	trot.
" " "	1-16	"	"	"	"	"	pace.
" " stone block	1-25	"	"	"	"	"	"
" " Belgian bl'k-							
Boulevard-Paris	1-40	"	"	"	"	"	"
" asphalt sheet.	1-133	"	"	"	"	"	"

Rearranging this information, we can say that a pull of one pound on an asphalt sheet-pavement is, as effective as,

One of	$4\frac{1}{2}$	pounds	on hard rolled gravel.
" "	$16\frac{1}{2}$	"	" cobblestone at a trot.
" "	$8\frac{1}{4}$	"	" " at a pace.
" "	$5\frac{1}{4}$	"	" ordinary stone block.
" "	$3\frac{1}{8}$	"	" Paris Boulevard Belgian block.

Passing to other characteristics of block-pavements, your attention is called to the necessity of cementing the joints so as to make it impervious to moisture and street filth, and to give it increased durability and good sanitary conditions. That this shall be done is assumed as a matter of course, whenever the community determines to avoid barbarous practices and secure high-class improvements. Having thus a block-pavement with a concrete foundation and cemented joints, we will find that it is not only less easily and more expensively cleaned, than is a sheet-pavement, and what is far more serious than this, is its noisiness under traffic. This objection has differing special significances to various people. To the nervous invalid, and to brain workers, it is so bad as to be prohibited regardless of other consequences. To the landlord whose property is depreciated from being within hearing of noisy street traffic and subject to the loss of rentals thereby, block-pavements are undesirable. In some communities the full import of this statement will not be perceived, but in such streets as Wall and Nassau, in New York, and La Salle, in Chicago, it is fully recognized. One of the finest office buildings in Chicago, desirably located, gets tenants for its quiet inside rooms, but not for the outside noisy ones, and the owners intend correcting the disadvantage by surrounding the building with an asphalt sheet-pavement in place of the high-class stone block which is there now.

The practical problem which interests us is, how to make the best selection of a pavement for use in any particular location. It is assumed that the location is in a city, and where dirt roads are no longer desirable, and that they are to be avoided. In other words, the pavement is to be kept well cleaned,—cleaned by scavengers in thronged streets and at increasing intervals, according to the decreasing volume of traffic, until the most private and secluded streets are attended to by being thoroughly swept twice a month. I hear pavements commended which are never swept during years of service, and which are so treated to insure their protection from abrasion by passing traffic. That community does not command the advantage of paved streets; what they really have is dirt roads with good foundations. Unless pavements are equally well cleaned there can be no fair comparison of their merits. To compare pavements on different streets, whether alike or of different kinds, they must not only be cleaned alike, but also must be kept repaired to like standard conditions of good order. In any case no ruts or depression should be allowed, for such being avoided by traffic lessen the use made of the street and destroys all chance for reasonable comparison with other pavements.

As a pavement is a construction, it necessarily follows that

there is a vast difference between the durability of the pavement and the durability of the materials of which it is made. The street may be impassible for traffic while filled with the durable paving material of a former pavement, and even while a claim might be set up for paving with such material because it was durable, which shows how important it is to always keep in view the method of a pavement's construction.

However important these many considerations are they are less so than another factor which should be always kept in view while weighing the respective advantages of different pavements, the use of which somewhere is referred to in proof of their desirability. I refer to the tonnage of the traffic they actually bear. There are, comparatively, but few streets in any of our cities with a traffic of over twenty tons per foot per day. That is 7,500 tons per year, and in twenty years is 150,000 tons. Now it is a daily occurrence to have pavements on streets with much less traffic praised for durability in contrast with another pavement bearing ten times their traffic, and affording as it would in two years more service than the other in twenty years. What would we think of an engineer buying rails for a railroad who should offset years of service on the main track with an equal number of years in a sidetrack; yet that is just what many paving advocates do.

To investigate the relative desirability of different pavements we must fix the definitions of certain terms and expressions which we use. In doing this, attention is first called to the necessity of establishing, to the satisfaction of all persons interested, an acceptable definition of the condition in which a pavement must be, to condemn it as being worn out. It is demonstrable that pavements, like all other constructions, are worn out when in such a condition that their further use costs more than would their immediate renewal. This definition relates generally to the financial aspect of the problem; and does not include an intangible value of pavements, which finds expression in likes and dislikes, and is covered by the word "desirability." Between two pavements, alike in cost and durability, people will have preferences, arising from the condition of their health, personal prejudices, and various other intangible influences, causing them to select one rather than the other for use in their respective streets. Such selections are often made against the demonstrated economies of the case, and usually in ignorance of them. Whenever one kind of pavement is more economical and more satisfactory to use than is any other, there should not be any difference of opinion about securing it either as new pavement, or as to the repairing, or in the replacement of an old one.

So also a defective spot in a pavement demands repairing, just as soon as the disadvantages which it imposes upon the traffic is more than the cost of repairing it. This means practically that instant repairs are consistent with the utmost economy. Yet claims are made that particular pavements cost little or nothing for repairs, simply because the repairs are not made, and while anyone can see the need for them. Whenever even a single square foot of pavement is so bad that if the whole of it were in like condition, the whole would be condemned, then of course that particular square foot should be condemned and put in good condition.

There is some confusion in the use of the words "durability," "serviceability" and "desirability" in speaking of street pavements.

The durability of a pavement is its quality, which relates to the length of time during which it is serviceable; and the relative durability of pavements is determined by comparing the gross tonnage of traffic over them, without regarding the cost of the service.

The serviceability of a pavement is its quality of fitness for use, and a comparison of pavements in this respect is effected by determining the tonnage of traffic which each will bear for some amount, say one cent of annual cost.

The desirability of a pavement is its possession of qualities which make it satisfactory to most people seeing and using it. A comparison of pavements in this respect must be made by taking into account their estimation in the minds of people who conduct traffic over them, also certain sentimental or intangible considerations, like those arising from witnessing cruelty to animals, which many persons feel who do not use the streets. Popular prejudices about pavements affect the prices of real estate upon paved streets, and so help to determine their desirability.

A pavement so rough that traffic is kept off the street might be a most durable one, but certainly would be lacking in serviceability. In a general way of speaking, the value of city property depends upon the volume of the traffic in the street upon which it is located. Ordinarily a pavement is not wanted by the owners of property on the street, however durable it may be, if it lacks in serviceability, and they may not want it, even when it is serviceable, if it is not also popular.

In comparing pavements, no traffic should be counted after the time when a pavement is in such a condition that its use will cost more than its renewal, as previously explained. Nor should a pavement be credited with traffic unless it is kept clean and in good repair; for an inch of dirt will protect it from abrasion for an indefinite period of years.

Proceeding to consider pavement economics I will present the matter in the relation which it holds to the owner of a city lot of average width which is assumed to be assessable for one thousand square feet of street pavement. The relative economies of pavements, whether of the same kind in different condition, or of different kinds in like good condition, are sufficiently determined by summing their cost under the following headings of accounts:

First—Annual interest upon their first cost.
Second—Average annual expense for maintenance and renewal.
Third—Annual cost for custody (sprinkling and cleaning).
Fourth—Annual cost for service and use.
Fifth—Annual cost of consequential damages.

First—The first cost of a pavement is, like that of a turnpike, plank road, or railroad, a permanent investment, measurable for purposes of comparison by the amount of annual interest on the sum expended. Thus, as an illustration of the application of this measure of comparison, the annual tax due to the original cost of pavements, assuming the worth of money to be 5 per cent., a pavement costing $2.79 a sq. yd. entails an annual interest loss or tax of $0.1395; and 1,000 sq. ft. of it, an interest tax of $15.50, being 5 per cent. upon the $310 which it costs.

Second—The average annual expense for maintenance and renewal of a pavement is to be determined or calculated for the unit of the area as given above (1,000 square feet). Attention is called to the fact that the only way of arriving at a legitimate determination of these expenses, is to include all outlays for repairs and renewals, which are made from the time when the pavement is new and at its best, to a time subsequent, when by any treatment it is again made in equally good condition. The gross sum so derived, divided by the number of years which elapse between the two dates, gives an average annual cost for maintenance and renewal.

Third—Any pavement, to be considered as properly cared for, must be kept dustless and clean. While circumstances legitimately determine in many cases that streets must be cleaned at daily, weekly or semi-weekly intervals, the only admissible condition for the purpose of this analysis of street expenses must be that of like requirement in both or all cases, subjected to comparison. The cost of cleaning and sprinkling is to be calculated for 1,000 square feet.

Fourth—The annual cost of service of a pavement is made up by combining several items of cost incidental to the use of streets for traffic. For instance, such as limitations of the speed of movement, as in case where a bad pavement causes slow driving and the consequent loss of time; or cases where the condition of a pavement limits the weight of the load which a team can haul, and so compels the making of more trips, or the use of more teams, or cases where it causes greater wear and tear of the vehicles, of equipage and of horses. If a vehicle is run 1,500 miles in a year, and its maintenance costs $30 a year, then the cost of its maintenance is two cents to the mile run. If the value of the team's time is, say $1 for the legitimate time taken in going one mile with a load, and in consequence of bad roads it takes double that time, then the cost to traffic from having to use that one mile of bad street is $1 for each load. The same reasoning applies to circumstances where

the weight of load has to be reduced so as to necessitate the making of more than one trip. Again, bad pavements lessen not only the life service of horses, but also the value of their current service. The unit of these accounts is obtained by first finding the cost per mile of distance traveled, which cost divided by 5,280 and multiplied by 1,000 gives the desired result.

Fifth—The determination of consequential damages, arising from the use of defective or unsuitable pavements, involves the consideration of a wide array of diverse circumstances, only the more important of which are here mentioned. Some pavements when in their best condition are rough surfaced, and so give lodgment to dirt which can not be swept off. Such pavements require constant sprinkling to prevent dust from rising when the wind blows. The muddiness occasioned by the sprinkling is some disadvantage under any circumstances, and a material one on streets devoted to retail trade. If that particular disadvantge be appraised at so small a sum as $1.50 per month, or six cents per day, it exceeds the annual interest cost of the best quality of pavement, free from the disadvantage under consideration. Rough surfaced pavements are noisy under traffic and insufferable to nervous invalids; and much nervous sickness is attributable to them. To all persons interested in nervous invalids, this damage from noisy pavements is rated as being far greater than would be the cost of substituting the best quality of noiseless pavement. But there are, under many circumstances, specific financial losses, measurable in dollars and cents, dependent upon the use of rough, noisy pavements. They reduce the rental value of buildings and offices situated upon streets so paved—offices devoted to pursuits wherein exciting brain-work is required. In such locations quietness is almost indispensable, and no question about the cost of a smooth pavement weighs against its possession. Another consequential damage arises from neglected sanitary conditions. Unless a pavement is filth-proof, it is, next to bad sewers, the most efficient agency within a city for generating and disseminating noxious vapors and disease germs, now recognized as the cause of a large part of the sickness troubling mankind.

When an investigator has done the best he can to determine such a summary of costs of a pavement he may divide the amount of annual tonnage of the street traffic by the amount of annual costs and know what number of tons of traffic are borne for each cent of average annual cost, which is the crucial test for any comparison, as follows:

	A.	B.
First—Annual interest upon their first cost		
Second—Average annual expense for maintenance and renewal		
Third—Annual cost for custody (sprinkling and cleaning)		
Fourth—Annual cost of service and use		
Fifth—Annual cost of consequential damages		
Amount of average annual cost		
Annual tonnage of traffic		
Tons of traffic for each cent of cost		

To secure pavements that shall be durable and serviceable, the municipal authorities often require the contractor to guarantee his pavement for a term, usually, of five years, under provisions calling for maintenance in good condition during that period of time, and for final delivery in good order. Such contracts involve two kinds of service, that of construction and of maintenance for a limited period. In the latter the conditions are exacted indiscriminately, alike on streets with heavy traffic and on those with very light traffic, and thereby becomes sometimes burthensome, unless the same contractor paves so many streets of all kinds as to correct the inequality by securing a fair average traffic condition. The correct policy to pursue in contracting for maintenance would be to measure the service of the pavement by tonnage rather than by years. To do this equitably, the city needs information about the traffic, which it can obtain only by having a census of it taken, as experience shows can be readily done.

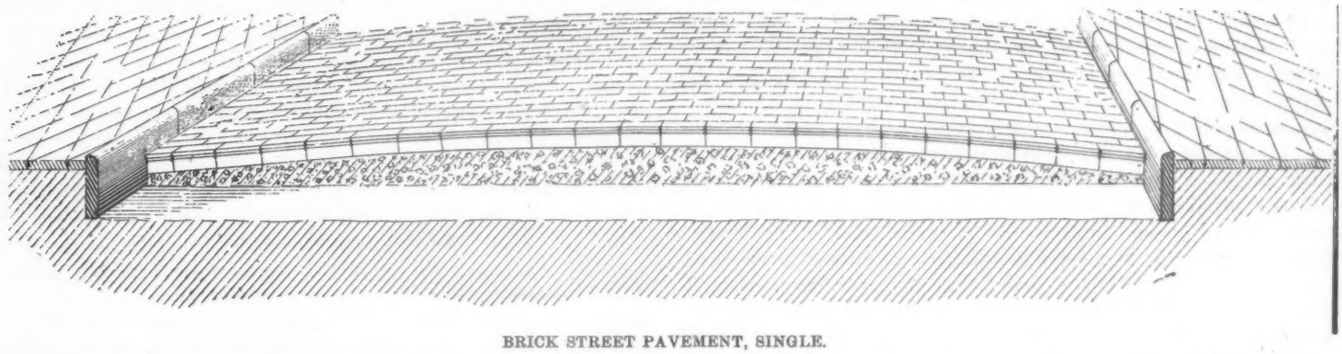
BRICK PAVEMENTS.

By D. T. Praigg.

IN such an era of material progress as that which is now known to exist in every city, in every town, in fact, throughout the country, it would indeed be strange if the subject of street paving were not attracting more attention from city and town officials than any other one thing which so nearly affects all classes of their constituency. The capitalist erects a magnificent block or a palatial residence, and adorns his lawn with improved walks, ornamental shade trees and fragrant flower beds, regardless of what his near or remote neighbors may have done in the way of improvement and without reference to the particular line of taste which they would follow under similar circumstances. But different elements enter into those improvements which are private in a sense, and yet public in a broader meaning, and which represent not an individual, but a community of interests. A stranger's impression of a city or town depends largely upon the ease with which he can go from place to place in the transaction of business or in the pursuit of pleasure, and he is pleased or displeased exactly in proportion to the smoothness of his journey or the ruggedness of his way. Massive business blocks, pretentious private residences, stately public buildings, beautified parks and lawns possess no attraction for one who is compelled to pick a way for his feet and keep his eyes upon the ground for fear of stumbling over jagged stones and falling into mud which represents the accumulation of months of the wet season. To man and beast alike, the roadway that offers few or no obstacles to easy travel is a delight which shortens the journey by taking the curb from time and lending it a spur.

What shall constitute these roadways, out of what shall they be constructed, is the only question that forms the basis for a difference of opinion, for all are agreed that the present generation and the generations to come will no longer be content with the corduroy road of our ancestors or with the bowldered pavements which became hardly less objectionable successors. The first has passed into history as a device which substituted bounding in the air for sticking fast in the mud, and its successor is gradually disappearing under the influence of that higher civilization, push and energy, which requires that the greatest possible amount of business shall be transacted in the least possible time and that the fewest possible obstacles of inconvenience of locomotion shall stand in the way of its thorough accomplishment. To the consideration, then, of what the pavements of the present and future shall be constituted is brought the thought of the present, and there is hardly a city in the land in which there is not given to this subject more or less careful study. First cost in construction and second cost in repairs, which necessarily includes durability, are the only two elements which can properly enter into a consideration of this subject in its relation to expense, for smoothness of surface, an important element and one that demands equal consideration, depends more in all modern pavements, upon the foundation on which it rests than upon the material that enters into the composition of the wearing surface. "The best is none too good" should be the controlling maxim, for the best is always and necessarily the cheapest whatever may be its relative first cost when compared with the price of the poor or the indifferent. But it does not follow that the best is always the highest in price, for this depends largely upon the proximity of the material of which the pavement is made, whether stone, brick or wood, to the place where the pavement is to be laid. Governed by the ordinary prudential considerations that obtain in careful business transactions, and applying the maxims which long business experience have demonstrated to be absolutely reliable, we would say that when the question of the best paving material has been fully canvassed and satisfactorily settled there should be no compromise between it and confessedly less worthy material. When it once becomes known that practical and trustworthy tests have been made and the best decided upon, and that the people will have none but the best, the demand for the favorite material will be such that there will be active competition between manufacturers and prices will regulate themselves accordingly.

Until quite recently there were three favorite materials out of which pavements were constructed—stone, asphalt and wood—and they stood, in the estimation of engineers and contractors, about in the order in which they are enumerated. The stone pavements were made principally of granite blocks, and are certainly to be commended for their durability on streets which meet the heaviest demands of business traffic. The principal objection to them is the noise, which is greater than on any other kind of pavement, and for this reason practically unfitting them for residence streets. Asphalt stood next in esteem, but experience has demonstrated that it is not best suited to heavy traffic, though an admirable material for residence streets if heavy wagons can be prevented from traversing it. In the majority of places where it has been tried, however, it is found that heavy traffic gravitates to the asphalt streets, owing to the smoothness of the surface, and the advice of such cities is that when asphalt is used at all there should be enough of it to prevent that discrimination in favor of a few streets that draws all traffic to them. In cities which have a few thoroughfares paved with asphalt, it has been the experience that hundreds of wagons, heavily loaded, that could reach their destination by shorter routes, make long digressions for the sake of the better surface which the asphalt presents. The result of such conditions is seen in the frequent repairing of the street, which would subject the city to great cost except for the guarantee given by the contractors at time of construction. It possesses a great value, however, in being almost entirely free from noise and in reducing the wear and tear of vehicles to the minimum, and in being practically free from dust. Third in order stood the wooden block pavement. Like the asphalt it is unsuited to heavy traffic, and experience has demonstrated that it wears unevenly.

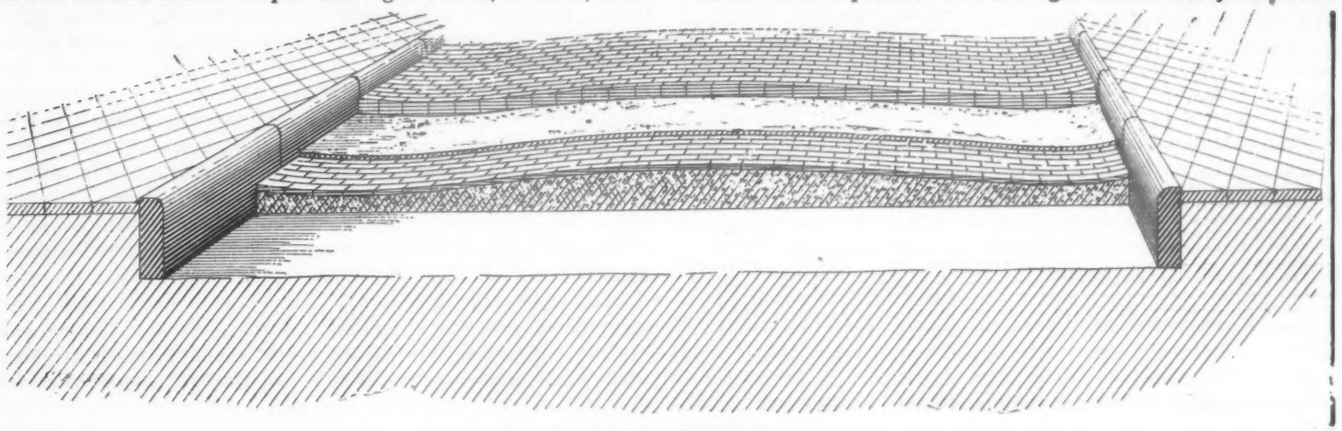


BRICK STREET PAVEMENT, SINGLE.

Within the last few years attention has been strongly directed to vitrified brick as a paving material, and the results of investigation have been such that there is little question but that it will grow rapidly in public favor. It is smoother and less noisy than the granite block, and experience has fairly demonstrated that it may be made more durable than the asphalt or the wood, thus possessing the most desirable elements in a large degree. The first brick pavement in this country was laid in Charlestown, W. Va., in 1874, and is still, after sixteen years, in very good condition and bids fair to last another sixteen years. Brick-paved streets have been in use for different periods, ranging from one to eight years, in Decatur, Lincoln, Champaign, Galesburg, Peoria and Bloomington, Ill., Lincoln, Neb., Des Moines and Burlington, Ia., and Cleveland and Columbus, O., and in each are giving satisfaction.

A properly constructed brick pavement makes travel easy for horses, and relieves them from much of the constant strain to which they are subjected by other block pavements. It is free from the objection of slipperiness in a larger measure than either stone or asphalt, and affords a sure foothold. When bedded in sand, with proper foundation, brick are somewhat elastic and are comparatively noiseless. No pavement can be more easily repaired, and it is as free from dust as the sheet pavements. While the point is made that the use of brick in this country is still in experimental stages, it is a fact that in other countries, notably in Holland, it has been in popular use for more than half a century, and there is no reason why it can not be made as serviceable and satisfactory in the United States as elsewhere.

The city council of Peoria, Ill., has adopted a resolution to do all paving hereafter with brick, it being conceded that better results had been obtained from brick paving than from any other kind. The *Journal* of that city, in approving the resolution, says: "So far as the experience of Peoria goes almost every street that has been paved with brick is a success, and half a dozen different kinds of brick have been used. * * * The block that was first put down on Hamilton street, opposite the court-house, was paved with small, hard brick, and after six years of continuous wear, without any money expended on it, it is as good as the day it was put down."



BRICK STREET PAVEMENT, DOUBLE.

Mr. William Steyh, city engineer of Burlington, Iowa, in an admirable paper read before the Iowa Society of Civil Engineers and Surveyors, made the following interesting statement regarding Burlington's experience:

"Burlington now has about 50,000 square yards of brick pavement, which will undoubtedly be doubled the coming season. We also laid about 3,000 square yards of granite block paving last spring which gives good satisfaction so far, but I do not think Burlington will lay any more granite in the near future as our citizens

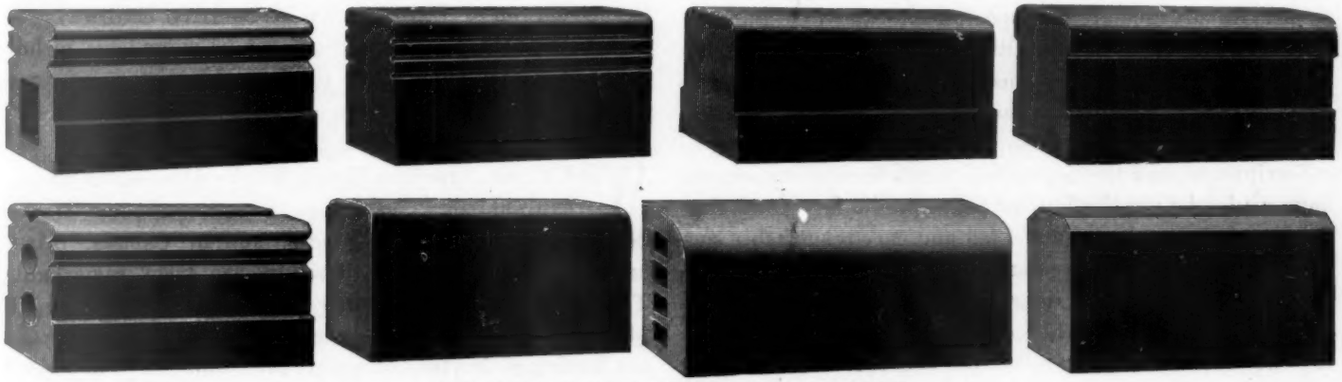
are all decidedly in favor of brick. In order to find out the strength for resistance of the brick used in our pavement I sent six samples to the United States arsenal at Rock Island, Illinois, to be tested. The following table shows the result:

Place of Manufacture.	Dimensions of two specimens.	Area of cross section.	Spauled at pounds.	Crushed at pounds.	Crushing strength per inch.
Burlington	7¾x3⅞x2⅜	9.2031	40,000	84,800	9,214.3
Burlington	8x3⅝x2⅜	8.6094	35,600	58,000	6,736.8
Galesburg	7⅞x3⅝x2⅜	8.9263	39,000	43,600	4,895.4
Galesburg	8x3⅞x2⅜	9.3031	30,000	47,200	5,128.7
Abingdon	7⅝x3⅝x2¼	8.4375	31,590	51,800	6,139.2
Abingdon	7⅝x3⅝x2¼	8.1562	37,700	46,500	5,017.2

"Taking the weakest of the samples, which commenced to spaul at 30,000 pounds for an area of a little over nine square inches, which would equal very nearly the area of that portion of the four wheels of a heavy farm wagon resting on the pavement at any one time, it shows that it would require extremely heavy loads to injure the pavement. As the brick pavement presents a very smooth surface the wear is not nearly as great as on granite and other stone block pavements."

The subject of brick paving is not only receiving considerable attention, but it must be conceded that the investigations have so far resulted in an agreement of opinion that it possesses advantages which are destined to make it the paving material of the future. It is a significant fact that in all the cities where it has been tried as an experiment it has resulted in its adoption without distinction regarding the kind of traffic which it will have to stand. It was shown in the tabulated statement of the cost of stone, asphalt, brick and wood in the preceding number of PAVING AND MUNICIPAL ENGINEERING, that the cost of brick pavements ranged from $1.30 to $2.68 per square yard. The same paving in Bloomington, Ills., costs $2 per square yard, which also included the stone curbing. Taking this as a fair average, it will be seen that its first cost is less than that of asphalt or stone blocks with either of which it compares favorably in point of durability.

It is not improbable that in many states may be found clay that can be made suitable for paving brick, and the cost of pavements must depend largely upon the proximity of this material. It is asserted by experts that there is plenty of the material in the country, and it is not hard to find when sought by a person experienced in clay working. The chief difficulty is to find it near a railroad and near enough to the surface to save the expense of shipping or mining. In speaking of this subject, R. R. Gray in a recent number of the *Clay Worker*, said: "What is wanted is a clay that will, when set 25 courses high in a down draft kiln, stand fire enough without losing shape until twenty at least of the twenty-five courses are vitrified. The remainder will then be hard enough for the bottom course of the street, or if they wont have them there, they will make first class sewer brick, which always command a good price." In conclusion it is with pleasure that acknowledgement of obligations is made to Messrs. J. W. Penfield & Sons, of Willoughby, Ohio, for the use of the cuts illustrating this article.



SOME FORMS OF PAVING BRICK AND CLAY CURBING.

TEST OF SIOUX FALLS GRANITE.

THE Bureau of Ordnance, United States Navy Department, last month made a test of two samples of quartzite or granite from the East Sioux Falls quarries, South Dakota, the crushing strength of which was found, by James H. Windrim, supervising architect, to be equal to the capacity of the testing machine, which is 85,000 pounds. None of the samples showed any signs of weakness under the pressure of 85,000 pounds. The stone is being very largely used for street paving, over 180,000 square yards having been put down in Chicago.

A DEMAND FOR BETTER STREETS.

The city of Evansville, Ind., is fully aroused to the need of better streets, and much paving will be done there with as little delay as possible. The Business Men's Association is taking a hand in pushing the work, and at a meeting held the latter part of last month adopted the following report from a committee on improvements:

"Your special committee on the improvement of streets begs leave to submit to this association the following report and recommendations, which in turn we hope this association will endorse and recommend to the common council of the city of Evansville:

"Upon full investigation we are convinced that the days of the macadam, broken rock, or gravel street, or combination of all these are numbered, and that the brick street, made of the proper quality of brick, regular building size, upon proper foundation, is the coming street. It is attractive, lasting, free from dirt and dust, and, all things considered, cheaper than any other improvement that can be made.

"We recommend that all improvement of streets by bowldering, graveling or macadamizing, or any combination of broken rock and gravel, no matter of what kind, shall immediately cease. Money spent in such improvements is wasted. We appeal to the experience of the members of this association for confirmation of this statement, which we make without blame or censure to any one.

"We recommend that all repairs of streets, improved or unimproved, by bowldering, graveling, macadamizing, or by any combination of broken rock and gravel, no matter what kind, shall immediately cease. It is better and more economical that the improved streets we should now wear out; when worn out, they ought to be made with brick.

"We recommend that in the residence portion of the city, and on those streets that are partially devoted to residence and business, that only twenty four feet of the width be improved, and that in the center of the street; that the portion remaining unimproved between the sidewalk and driveway may be parked, laid out in a grass or flower plat, as the taste of the abutter may dictate."

WESTERN BUILDINGS AND PAVEMENTS.

THERE is too much wood used in our western cities. There are too many flimsy structures. The best of our western cities are marred by the suggestion of architectural flimsiness, which certainly is allied to financial infirmity. And when a western city reaches that point where it begins putting up great seven-story and eight-story stone and brick structures there certainly is an incongruity in their contrast with a rickety and short lived wooden pavement. This may seem at first glance a trivial consideration, but it is not trivial by any means. If a city wants to be regarded as "solid" it must look solid.—*St. Joseph, Mo., News.*

Paving and Municipal Engineering

A Journal Devoted Specially to Street and Sidewalk Paving, Sewerage, Water-Works Construction, Street Lighting, and all Matters Pertaining to Municipal Engineering.

Published on the 15th of Each Month.

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Communications are invited, and all requests for special information on the subjects treated by this journal will receive careful attention.

Articles relating to the different branches of municipal engineering are desired. Stamps should accompany manuscripts for return postage if unavailable.

AN EXTRAORDINARY BEGINNING.

SO far as we have been able to learn, no monthly publication in the United States devoted to special interests, has ever had a more auspicious beginning than PAVING AND MUNICIPAL ENGINEERING. This, doubtless, is very largely due to the generally felt need of such a publication, as was indicated by the commendations of the contemplated venture that came to the publishers from all parts of the country in advance of the appearance of the first number. The very gratifying favor with which the publication has been received is not only encouraging, but really imparts something of enthusiasm to the managers of the enterprise. The demand for copies of the paper, the great inpouring of subscriptions, and the approving words from many sources have made the publication, so far as public favor and support are concerned, an undoubted and very remarkable success from the start. We can give the assurance, however, that it will continue to improve with every number. Below are given some of the complimentary remarks regarding the journal in letters to the publishers:

GOVERNOR'S ISLAND, NEW YORK HARBOR, June 24.—Your first number arrived and you are to be congratulated on the excellent beginning. The enormous sums of money yearly expended in paving warrant a publication well edited, independent and energetic. Your paper will materially aid in securing an economical application of the yearly millions put into pavements. You will also educate many to know just what good streets are and what a blessing they become to a community in a thousand ways, beside their great economic value. * * In former years I had occasion to live and study in France and Germany, where I have often noticed just such publications—one in France and one in Germany—as this one you are now starting in our country. J. W. HOWARD.

LEXINGTON, KY., June 22.—I have read with much pleasure and profit the June issue of PAVING AND MUNICIPAL ENGINEERING, and I wish your venture success. * * Our city government in response to an almost universal demand of the people has inaugurated plans for the reconstruction of our streets with brick, and we want to put down eight or ten millions of brick this season. I realize the fact that your paper will be of great value in bringing our wants before the brick contractors and also keep us informed in regard to the progress of similar work in other cities.

H. T. DUNCAN, Chairman Improvement Committee.

GREENVILLE, O, June 26.—I am highly pleased with the first number of PAVING AND MUNICIPAL ENGINEERING. It will certainly meet with marvelous success. JOHN BEERS.

CLINTON, IA., June 23.—I anticipate from its objects that your journal will meet with very marked success. B. B. HART, City Engineer.

ZANESVILLE, OHIO.—I like the idea of a paper that fills the long needed place. It is singular that every industry that has a few hundred thousands of capital invested only in the whole United States has one or more papers or organs to represent it, and right here is an industry that has been for many years way up in the millions and this year will nearly double, and not a single paper or journal of its own. You ought to have a very extensive patronage. A. O. JONES.

BURLINGTON, IOWA, June 17.—I wish you abundant success in your laudable effort. WM. STEYH, City Engineer.

READING, PA., July 2.—I am very much interested in your new journal and trust you may be successful. All cities and all thoughtful citizens need more intelligent information in reference to the improvement of our streets. THOS. P. MERRITT.

RACINE, WIS., June 26.—I think it is just the publication for municipal engineers, as it is devoted to municipal work, and fills a long felt want. C. F. KOHLMANN.

Although the edition of our first issue was as large as it seemed there could possibly be use for, it was very soon found inadequate, and an even larger supply of the present number will be printed. It is common for exaggerated statements to be made regarding the circulation of publications. We do not care to be judged doubtingly by the distrusted practice in this respect, and we, therefore, beg those who desire the most trustworthy information as to the circulation of PAVING AND MUNICIPAL ENGINEERING to ask the Indianapolis post-office how many bags, or how many hundred pounds of the monthly issue are sent through the mails.

FUTURE OF THE WATER-WORKS BUSINESS.

WHEN the American Water-Works Association was organized nine years ago, there were in the United States 626 water-works plants, and in Canada, thirty-one. The growth of the business has been remarkable. There were at the beginning of the present year 1,820 plants in the United States, and eighty in Canada, the number having within ten years more than doubled. The growth of the business, during the next ten years promises to be proportionately even larger. There was a time when water works plants were thought of as being desirable only for cities and towns of large growth, but now in every progressive community of any considerable number of people, water-works are being brought into use as a convenience, if not a necessity, and the development of the country, the enterprise of growing towns, the reduction in the cost of plants, and the great improvement in the systems over all other kinds of water supply will make the business more general in the future. Every town of any size will have water-works, and instead of an investment of capital amounting to $500,000,000, with annual revenues approximating $50,000,000, in another ten years, the business, it may be safely predicted, will have grown into ten figures.

The progress made in the development and improvement of water-works systems has been wonderful. Speaking of what had been accomplished in ten years President Decker, at the last annual meeting of the association, said:

This same period has given birth to the mechanical filter; it has given most marked improvements in our pumping engines; a higher degree in the efficiency of the meter, and a degree of excellence in all classes of supplies hitherto only hoped for. To those of us whose experience dates back into the decades prior to the last the progress is wonderful, and we have but entered upon

this age of progress. Those of us who may be spared—and it is the sincere wish of your chairman that it may be every one present to-day—to meet at our next decennial gathering will have in their various works appliances beyond anything now thought of. The great demand of to-day is a satisfactory meter, and a satisfactory means of filtration, and I apprehend with confidence that through the effort of this association the time is not far distant when we shall have both. This is a part of the work we have in hand, and it behooves us to bend every energy to secure its fruition.

The possibilities of achievement in the perfection of methods give promise to the business of a greater future than we can now well imagine, and the vast importance of it, as affecting public health, as well as contributing to the comfort and convenience of life, make it, aside from the promise of profit, worth the best thought and efforts of men.

CHEAP PAVEMENTS.

FEW Western cities have given more attention to modern methods of paving than Omaha, where there has been much experimenting, with the result that much has been learned. Although a progressive spirit is evinced by those who are most influential in securing public improvements, there has been a very general demand from property owners, as in nearly every city, for the use of the material costing the least. There is too much of the average of human nature in the disposition to choose the cheap to expect due consideration to be given to the lasting economy of spending enough at first cost to secure that which is best and will call for the least expense in repairs. There has been and is being wasted a vast amount of money throughout the country in putting down pavements that have no greater merit than cheapness, and are chosen mainly on that consideration. While poorly paved streets are better than streets with no pavements at all, there can be no greater mistake in making improvements than to choose those kinds of material which have merely cheapness to commend them.

The Omaha board of public works, composed of St. A. P. Balcombe, chairman, William I. Kiersted and John B. Furay, discusses as follows the comparative merits of wood and brick from the point of view of cheapness, fairly and favorably to brick, but without doing full justice to wood, which may be made a better pavement than the article would lead one to believe:

A large class of taxpayers petition for the cheapest pavement, *in the first cost*, without regard to any other consideration, They overlook the fact that the cheapest, in the first cost, always proves to be the dearest in the long run, for it necessarily follows, that in the very near future, it must undergo expensive repairs, at the city's expense and then be renewed frequently at the property-holders' expense.

It is undoubtedly wise economy to lay none but the most substantial pavement and best, under the most approved methods of construction, *regardless of the first cost*, because the reputation and prosperity of any city depends as largely upon the condition of its streets and their proper paving as upon any other improvement, in fact more so. A city, with good streets permanently paved, and kept clean, denotes a thrifty, prosperous, wide-awake and energetic people. Illy paved and filthy streets are indicative of lack of enterprise.

But if any considerable number of our property-holders continue to demand cheap pavements, we would recommend to them the use of brick for residence streets instead of wood. We are confident that brick at $2.03 per square yard will outlast wood at $1.61, at least two to one, and yet the first cost is but a few cents more per yard, even under the present circumstances when we are forced to import the brick from Illinois in order to obtain suitable ones for paving purposes.

Our brick manufacturers are industriously hunting for, and will undoubtedly find, the right kind of clay for paving brick in this vicinity. As soon as it is found brick pavement will be cheaper than wood.

The most ardent advocates of brick openly confess that clay, suitable for paving brick, is only found in but a very few locations in this country as yet. Those best informed say only in Illinois, Ohio and West Virginia. They say it must be a clay which will make brick that will burn to vitrification in a closed kiln, without running together, and make not only a hard, but a decidedly tough brick, which will not easily chip nor mar in any way—one that will not absorb more than 2½ per cent., or 1-40 of its weight of water, and therefore resist disintegration by frost. They say that a clay which contains considerable lime is unsuitable; that clay belonging to the coal measures is indispensable.

Such clay has not been found in our midst so far. Hence we have imported brick from Galesburg, Ill., with the view of having the best for the first experiment, and placed 77-100 of a mile of one course of said brick, set on edge, on a six-inch concrete base, at a cost of $2.14 per square yard, and have an uncompleted contract for more, at $2.03.

Experienced experts in Europe and America pronounce a concrete base an absolute necessity to maintain the contour of the streets and for the stability and endurance of all kinds of pavement. It secures a hard, even, smooth and durable surface, and protects the top material from the destructive influences of the frost underneath. Therefore our specifications require one course of brick on a six-inch concrete base, instead of two courses on a sand base, as laid in some other cities. We deem a concrete base especially desirable under brick, and more necessary than when any other material is used, on account of their narrow bases, which will yield in detail when under heavy pressure and jolting, thereby forming ruts and result in unevenness, if there is not an unyielding foundation under them.

In a sanitary point of view brick is manifestly superior to wood. It does not itself decay, and being impervious to water, it does not absorb the liquid filth of the street and give off offensive and poisonous effluvia, but wood does and is very pernicious to health after it begins to decay.

Brick pavements are more easily repaired than wooden. If a brick prove to be imperfect, replace it with another and the work is done. They are not as slippery as wood, owing to the small surface between seams. They are equally as smooth in surface, as noiseless and as pleasant generally to drive over as the wooden.

We reiterate that the policy of buying the lowest-priced article for use in perpetuity is no more commendable in the case of paving streets than in the affairs of domestic and business life, and we do not intend to commend any cheap pavement, but to commend one cheap article in preference to another. Hence we say, choose brick instead of wood, if determined to have one of the lowest in first cost.

The remarks of the Omaha officials, in the main correct and sound, are open to the objection of being based on the mere consideration of cheapness. Both brick and wood have more merit than cheapness. There was much wisdom in a remark that was made in a letter from Mayor Bruck, of Columbus, O., in a letter published in the last number of PAVING AND MUNICIPAL ENGINEERING, and it is strikingly applicable in this connection. He said: "I think our experience will justify the opinion that *no* street should be paved with brick or any other material on account of being cheap. The best pavements are the cheapest."

Mayor Nast, of Boston, gave equally good advice when he said: "In making streets, as in procuring a water supply, go for the best, and pay for it."

CAPABLE and honest engineering ability is needed by every city. Valuable men can not be secured for small pay. It is the poorest economy to seek the cheap kind. An engineer who is worth a salary of $4,000 or $5,000 a year, which seems large to many, is as cheap as it is safe for any city to employ. A cheaper engineer is likely to be a very costly one to the city employing him. The ability required is of a kind that may be of great value or great cost, and a city can not be too careful in the selection of the men who are to have supervision of public improvements, and should pay liberally for good service. It is profitable to do so. Kansas City has acted sensibly in amending its charter so as to require the president of the board of public works to be a civil engineer and to perform the duties of the city engineer at the same time. The change gives intelligence and skill the power that it should have, instead of making it subordinate to inexperience, as is the case where engineers are hampered by all of their suggestions being made subject to the approval of a board of men who have no thorough knowledge of the technical work of which they have charge. The change should, and doubtless will, prove beneficial and profitable to the city.

THE Omaha board of public works reports that all public improvements in that city last year were let at lower prices than ever before, while at the same time contractors were held closer to compliance with the stipulations of their contracts, and under specifications more favorable to the city than those of previous years. This evidently was the result of competent and careful supervision, which, at what may seem very high cost, is the cheapest service any city can secure in undertaking public work. For information the prices paid for paving in Omaha, as reported by the board of public works, are given: Sheet asphaltum, $2.34 to $2.78 per square yard; Sioux Falls granite, $2.27 to $2.37; Colorado sandstone, $2.12½ to $2.27; Woodruff (Kan.) sandstone, $2.19 to $2.27; Galesburg brick, $2.03 to $2.14; cedar blocks, $1.37½ on sand and plank to $1.61 on concrete; cypress blocks, $1.37½ to $1.62. Curbing prices per lineal foot were, for Berea sandstone, 69 cents, and Colorado sandstone, 71 to 79 cents.

THERE is nothing more ruinous to streets than the practice of cutting into new pavements for the purpose of doing underground work, most of which could very easily have been done before the completion of the pavement. The department of public works in Philadelphia very rigidly enforces a rule, which should be adopted in every well-managed city, against cutting into pavements except in cases of most serious emergency. Before any new paving is commenced, notice is served upon interested property-owners to make all necessary connections with sewer pipes and conduits, and if they fail to obey the instructions they must bear the hardship of doing without such connections. It is a thoroughly good rule, and is the only protection against the early ruin of new pavements in cities which have no underground pipe system.

THE reports of John S. Shultz, city surveyor, and John Blowe, supervisor of streets and highways, of Camden, N. J., for the last year, have just been published. It gives a vast amount of statistical information regarding the paving of Camden streets, over a mile of which were improved last year with Belgian blocks and asphalt. Contracts have been awarded for much more work. The report states that the "streets are in fairly good condition." A new departure by the city is the repairing of its streets by a corps of its own employes. Heretofore, the work has been done by contract, which, the officers say, "resulted in giving the city poor work at unsatisfactory prices." The repair corps is employed ten months of the year. The same method is followed in the repair of sewers, with equally satisfactory results, the work being better than when done by contracts and all needed repairs are much more promptly made.

IN the next issue of PAVING AND MUNICIPAL ENGINEERING, will appear a special article on "Real Asphaltum—How to Tell It," written by Mr. J. W. Howard, B. L., C. E. of New York. It will give information particularly valuable to those interested in asphalt paving.

TESTS OF PAVING BRICKS.

THE Omaha board of public works recently made a test of paving bricks manufactured at points most convenient to that city. The test was for absorption, resistance to impact, and crushing strength. The results were as follows:

	Per ct. Abs'rption.	Crushing strength sq. in.	Per ct. Loss of weight.
Diamond Brick Co	.008	12,286	.028
Beattie and Benning	.005	12,472	.030
Drury B. & T. Co	.012	10,583	.125
Beatrice Paving & Building Brick Co	.049	5,956	.134
Beatrice Sewer Pipe Co	.077	6,220	.149
Joseph Deiss	.056	9,714	.140
Dawson, Ia	.041	8,686	.147
Galesburg	.008	7,534	.179

THE COMMON DIRT ROAD.

To the Editor of Paving and Municipal Engineering:

Referring to the common dirt road, we respectfully submit that where two parallel, central, longitudinal lines of tile are laid with the proper grade or incline to the outflow, which may be a tile or wood box at stated intervals, and especially at intersecting roads, the roads will always be dry and as hard as the nature of the soil will admit. A 30″ cover ditch is desirable, although variations would of course occur.

My axiom is that Water
and
Frost
and
Death are partners in the destruction of roads, streets, foundations and concretes. Lead the first out and the other two will not come in.

Respectfully, W. L. S. BAYLEY, C. E.

CHICAGO, June 23.

Paving and Grading.

Broadway, at Mattoon, Ill., will be paved.

Shatteck avenue, Berkeley, Cal., will be paved.

At Palatka, Fla., Lemon street will be paved.

Phillips avenue, Sioux Falls, S. D., will be paved.

Extensive brick paving will be done at Clinton, Ia.

Golden Gate Park, at San Francisco, will be improved.

University Avenue, St. Paul, Minn., will be improved.

Perry avenue, Decatur, Ill., will probably be paved.

Extensive street work will be done at Tacoma, Wash.

West Broad street, Savannah, Ga., will probably be paved.

Macon, Neb., has voted $100,000 interception paving bonds.

The agitation for stone paving still continues at Reno, Col.

Florence, Wis., is making important street improvements.

Thirteenth street, Louisville, Ky., will be paved with gravel.

South Sixth street, Nebraska City, Neb., will probably be paved.

Extensive street and sidewalk work will be done at Helena, Ark.

Sault St. Marie, Michigan, is agitating improved county roads.

At Keithsburg, Ill., numerous streets will be paved with brick.

Cavin street, Ligonier, Ind., will probably be paved with brick.

Webb and Rosenberry streets, Alliance, O., will probably be paved.

Stockton, Cal., will probably improve streets at a cost of $195,000.

Lincoln, Neb., has voted $100,000 of bonds for paving street intersections.

An ordinance has passed the council for paving Olive street, Kansas City.

It has at last been definitely decided to pave Sixteenth street in Reno, Col.

The St. Louis council will probably pass an ordinance for paving Fifth street.

The improvement of Grand View avenue of Dubuque, Ia., is being agitated.

At Oshkosh, Wis., a petition is being circulated for the paving of Oregon street.

An ordinance has passed the council for the paving of Fifth street, at St. Joseph, Mo.

An ordinance has passed the council for the improvement of Sixth avenue, Topeka, Kan.

U. Stenger has the contract for the construction of Breckinridge street, at Louisville.

The Butte City, Mon., Real Estate Exchange is agitating the question of better streets.

Tayne, La., wants bids for grading and ditching all the principal streets and ditches in town, the work to be completed September 15th.

The Arnold Improvement Co. has contracts for extensive street paving at Evansville, Ind.

O. H. Musgat has been awarded a contract for paving Second street, at Fond du Lac, Wis.

Ordinances have passed the council for paving the principal streets of East St. Louis, Ill.

Lake street, River Forest, Ill., will probably be paved with cedar blocks or macadamized.

The Washington C. H., Ohio, council has passed ordinances for paving numerous streets.

The Duluth, Minn., Board of Public Works wants bids for paving 4th street, to cost $48,000.

Jas. B. McCreary has a contract for the improvement of Bayne street, at West Cleveland, O.

The Sioux Falls Granite Company now has some 400 men employed in its quarries at East Sioux Falls.

The Salt Lake City council has granted permission for the paving of Commercial street, with Utah asphalt.

The county commissioners have let a contract for a plank road six miles north from Whatcomb, Wash., for $24,000.

Lafayette avenue, Detroit, Mich., will be paved with asphalt. Napoleon street will be paved at a cost of $11,415.91.

There is agitation in Cleveland in favor of putting an asphalt surface on the Euclid avenue Medina stone pavement.

The Nashville, Ill., council is considering street paving, and will pave a section of Main street as an experiment.

It has been decided to use Colorado sand stone for the curb and asphalt for the paving of Franklin street at Omaha.

The Southern Paving Company has commenced the manufacture of asphalt paving blocks at Fort Paine, Ala.

The Grand Rapids (Mich.) city engineer has submitted an estimate for paving Canal street with asphalt, to cost $15,000.

The Corsicana, Texas, Council has let the contract for paving Beacon and Colling streets, to Messrs. Howard, of Dallas.

Chicago people complain that their wood block paving will cost from 15 to 20 a square yard more this year than last.

At Ferguson Station, Ky., large asphalt beds have been discovered, and they will probably be developed for paving purposes.

J. A. Stewart will probably be awarded the contract for paving the new market grounds, at Detroit, with brick, at $28,000.

The Kansas City council has decided to establish the grade of Broadway from Twenty-third to Thirty-first street at a cost of $70,000.

At Davenport, Ia., Edwards & Walsh have been awarded a contract for eighteen blocks of brick pavement. Their bid was $65,525.90.

John A. Moore, a Pittsburgh paving contractor, has made a contract with A. O. Jones & Co. for 1,100,000 paving brick, for the streets of Braddock and Wilkinsburg, two important suburban towns adjoining Pittsburgh.

The Corsicana (Texas) city council has employed C. W. De Zoucho, of Dallas, to make plans for, and take charge of, paving the streets.

Hon. N. D. Wiley is a member of the commission to locate the Salmon Meadows and Mount Idaho wagon road at Boise City, Idaho.

An ordinance has passed the council for paving and curbing Northrop avenue, Kansas City, Kan., between Ninth and Tenth streets.

The Claflin Paving Company and John R. Miller have been awarded contracts for paving 19th street in Toledo with cedar blocks, at $4,250.

The contract for the large amount of granite, recently reported as advertised for at Louisville, has been let to M. W. McComas, of Lithonia, Ga.

The street paving in the two Kansas Citys for the year 1889 cost in round numbers, $656,173. One-half of this amount was sent abroad for material.

The Morgan Engineering Company of Alliance, Ohio, has offered to pave Morgan street, Massillon, Ohio, from Broadway to Oxford, at its own expense.

The Chattanooga, Tenn., Board of Public Works has decided to improve five miles of streets with asphalt, brick and granite, and bids will be advertised for at once.

The Buffalo Paving Co. has been incorporated at Albany, N. Y., by J. B. Manning, A. F. West and G. Sandrock. The company will use Kentucky rock asphalt.

C. W. McKinney, of Toledo, O., has the contract for paving 21st street with cedar block at $4,322.30. He also received the contract to pave Division street with fire brick at $24,000.

Dale & Baumgardner have been awarded the contract for grading Fairview street, St. Paul, at $39,990. The contract for grading Minnehaha street has been let to James Claffey at $10,977.

The Port Townsend, Wash., county commissioners have let a contract to Hakes & Donahue for a county road from Chimacum to Quilone, a distance of twenty miles, at a cost of $25,000.

The Berkley Macadamizing, Bituminous Rock and Asphalt Company has been incorporated at Berkley, Cal. The stock is $20,000. W. J. Schmidt, A. A. Fruk and W. H. Baker are the directors.

At Burlington, O., N. R. Durby and others have petitioned council for the paving with brick of Franklin street. N. S. Young has the contract for grading, curbing and paving with brick Angular street.

James A. Lindsay, city clerk of Cleveland, O., wants bids at once for the paving of Mechanic street with vitrified brick. There will be 5,970 square yards of paving, and 3,125 lineal feet of curbing.

An organization with the following officers has been formed, to secure the construction of a boulevard along Prairie Creek at Denver: President, R. W. Speer; Secretary, John Leet; Treasurer, James Leonard.

C. F. Hoyt is about to engage in the manufacture of paving brick at Sioux City, Iowa, with a view to supplying the demand in that section of the country. He will begin work with a capacity of 50,000 brick a day.

Architect Whitney, of Detroit, sometime ago sent two experienced carvers to East Sioux Falls to experiment with the stone quarried at that point. They found it of such a texture that it can be carved as well as any in the United States.

The extent and scope of the present summer's street paving enterprises in Davenport, Iowa, is practically settled. It will be confined to the more central part of the city—the most busy part. This is the decision of the paving committee.

The Park Avenue Land Improvement Co. has been incorporated to secure the construction of a handsome boulevard to Grant Park, Atlanta, Ga. Its capital is $200,000. W. A. Hemphill, H. M. Cottingham, C. P. Swift and others are interested.

One of the new exhibits at the Indianapolis paving exposition is from the Improved Wood Pavement Co. of Mobile, Ala., and consists of cylinder blocks, cut from four kinds of wood—cypress, juniper, red cedar and hard pine. The pavement is laid, including grading and all material, for $1.25 a square yard, and can be replaced for 75 cents a square yard.

Through some inexplicable oversight, the exhibit of A. O. Jones & Co., of Zanesville, O., at the Indianapolis paving exposition, was not mentioned in the official report. The oversight was wholly unintentional, and is deeply regretted by the management; but it was remarkable because the exhibit was made specially conspicuous, and deserved creditable mention.

Sioux City is one of the latest places to awaken to the merits of brick as a paving material. A committee has lately visited Lincoln, Beatrice, Omaha, Atchison, Leavenworth and Kansas City, and in all of these cities they found brick paving growing in popularity. The experience of Lincoln, Leavenworth and Atchison had been the same, and in the last named city brick exclusively is now employed for paving, and her streets are the finest of any city's in the West. Every shower washes them perfectly clean, leaving the dark red glossy bricks shining like the tiles in a mosaic floor. Kansas City and Beatrice has also tried the brick pavement, and with them the experiment had been entirely satisfactory. The verdict of the committee upon return was of a sort to m ke the people of Davenport feel encouraged with the work they are doing.—*Davenport Democrat.*

The new specifications for paving in Denver, according to the *Times*, of that city, call for Colorado sandstone on concrete, sandstone on sand and gravel, and asphalt on concrete, and provide that all pavements, curbing, flagging and crossings not guaranteed for any specified period, are to be maintained in good order one year from date of the approval and acceptance of the same at the expense of the contractor; and such pavements, curbing, flagging and crossings shall be certified as being in good condition at the expiration of said year by the engineer and board of public works before ten per cent. reserved shall be paid. Where pavements are guaranteed they will be maintained according to contract, and the city engineer will have the final decision on all questions pertaining to the acceptance of finished work. A concrete base will be placed under all paving now existing in between the cable tracks. All the curbing shall rest on a concrete foundation and have backing of the same material.

At St. Paul, Minn., Joseph Snyder has been awarded the contract for cedar block pavement on Crystal Block avenue, at 80 cents a yard. T. J. Canney has a contract for similar work at 83 cents a yard. The contract for curbing on both streets was let to the Parkhurst Combined Curb and Gutter Co.

Water-Works.

Griffin, Georgia, will build water-works.

The Merrill, Wis., water-works will be extended.

Water-works will probably be built at Oconto, Wis.

Water-works will probably be put in Astoria, Ore.

Ishpeming, Mich., has voted to build a sewer system.

Henderson, N. C., has broken ground for water-works.

The Marion, Indiana, water-works mains will be extended.

At Oaksdale, Col., a 15,000,000 gallon reservoir will be built.

The Port Townsend, Wash., water works will be built at once.

St. Johns, Iowa, will probably build a $5,000 water-works.

Lincoln, Nebraska, will vote June 26, on water bonds for $20,000.

Yoakum, Texas, has decided to advertise for bids for water-works.

Gainesville, Ga., has voted to issue $40,000 bonds for water-works.

The New Albany Ind., Water-works Company will extend its mains.

St. John's, Mich., has voted to bond the town for a water-works extension.

A. J. Miller has been granted a franchise for water-works at Centralia, Wash.

Redwood, Minn., is considering the building of a system of water works.

The water company will extend mains on the hill streets at Tacoma, Wash.

Victoria, B. C., will secure a supply of water from Elk Lake at a cost of $11,000.

A franchise has been granted to Donald McLean for water works, at O'Neill, Neb.

Water mains will be extended, and a new sewer system put in, at Grand Forks, N. D.

Sioux City, Iowa, will extend the water-works mains at an estimated cost of $25,000.

Aitkin, Minn., will investigate the feasibility of obtaining water-power from Mud river.

The Waupaca, Illinois, council is considering the question of building water-works.

Centralia, Washington, will grant a franchise to A. J. Miller and others for water-works.

Kansas City, Mo, will probably issue bonds for the construction of water-works.

A water-works system will probably be put in and a large reservoir will be built at Warrior, Ala. The Pierson Coal and Railroad Company will take one-half the stock.

At Frost, Tex., stock has all been subscribed, and work will soon commence on water-works.

The Goshen, Ind., council has appropriated $12,000 for the improvement of the water-works.

The San Diego, Cal., council is considering plans for the construction of a new water-works system.

The Waxahachie, Texas, council has granted franchises to the Waxahachie Water-works Company.

Sherman, Tex., has let a contract for $13,000 for an artesian well, 2,500 feet deep, for water-works purposes.

Alderman Welsh is agitating the question of a new $100,000 system of water-works for Astoria, Ore.

Coffin & Stanton, of New York, have bought the Crawfordsville, Ind., water-works, paying $106,700.

Capt. W. H. Armstrong, A. J. Piper and J. C. L. Ward will probably construct water-power at Irving, Kan.

H. E. Stevens has a contract to put in a sewer system at Lakeside and Lester Park at $26,500 at Duluth, Minn.

The Waco, Tex., Water and Power Company will erect a 30,000,000 gallon storage lake, and will also lay new mains.

Habbeller, White and others have asked a franchise for establishing an additional system of water-works at Sheffield, Ala.

The Oshkosh, Wis., Water-works Company will put in four large filter galleries, with a capacity of 2,000,000 gallons daily.

A contract for the water-works at Bigstone Gap, Va., has been let to the Glenmorden Iron Works of Lynchburg at $55,000.

The Spring Valley Water-works Company, will build large works to supply Ashbury Heights, near San Francisco, at once.

City Clerk P. E. Saunders, of Harvard, Ill., wants to correspond with water-works contractors regarding a system to be put in there.

The Somerset, Ky., council has let a contract to Capt. John Geary for the construction of water-works, with five miles of mains.

Galesburg, Ill., has decided to build water-works. Chester P. Davis, of Chicago, is the consulting engineer. The cost will be $100,000.

The Salt Lake City (Utah) council is considering a special tax levy for the commencement of the construction of a water-works system.

At Crystal Springs, Miss., water-works will be built. The artesian well system has been adopted. Henry Price is principally interested.

C. C. Garland, of the Garland banking firm of Minneapolis, is negotiating to put in a system of water-works to supply both Menasha and Neenah.

A resolution is before the water-works trustees of Cleveland for the extension of the lake tunnel two miles and for the construction of a new iron crib.

Pease & Metzgerol, Nashville, who have the contract for building a sewer system at Clarksville, Tenn., have thrown up the contract, and it will be re let.

The Houston Water Company, at Houston, Tex., will increase its capital stock to $150,000.

The Utah Water-works Company will probably buy the city water-works at Salt Lake City.

The Harvard, Ill., council has let a contract for constructing water-works to James H. Thompson, of the Western Construction Company, of Chicago.

Bridges.

The Grafton (W. Va.) town council will build a viaduct.

A $9,000 bridge will probably be built at Champa street, Denver.

A $3,000 bridge will be built across the Puyallup near Aldrich, Wash.

The Smith Bridge Company, of Toledo, has a contract for a bridge at Preston, O.

Four hundred feet of the pontoon bridge have been washed away at Lexington, Mo.

A bridge will be built over Indian Creek on East Broadway at Council Bluffs, Iowa.

Three large bridges over the Zumbro river have been washed away at Mazeppa, Minn.

The Saginaw, Mich., council contemplates the construction of a bridge at Hoyt street.

J. A. Curo has a contract for building two large bridges near the Bay front of Duluth, Minn.

A company has been organized to build a bridge across the Cimaroon River, at Guthrie, Okla.

An Oregon railway and navigation company will build a large bridge across the Columbia river.

The county supervisors have decided to build a $6,500 iron bridge across the river near Afton, Wis.

The Oakland, Cal., County Supervisors will build a bridge across Sausal Creek on East 16th street.

Richmond Pierson contemplates building an iron bridge across the French Broad River, at Asheville, N. C.

Kiowa, Kan., is circulating a petition for a bridge across Medicine River. Medicine Lodge is the county seat.

The Wheeling & Lake Erie bridge at Green Creek, O., has been burned. It may be rebuilt as an iron structure.

The Detroit Bridge and Iron Company has the contract for building the large iron railway drawbridge at Ferndale, Wash.

T. & E. Lane, of Chicago, will probably be awarded the contract for replacing the wrecked bridges of Rockford, Ill., at $2,500.

The much-agitated High street viaduct at Columbus, O., will probably be built. The city engineer has been instructed to make plans.

The Smith Bridge Company, of Toledo, has the contract for the superstructure of the Twenty-first street bridge of Birmingham, Ala., at $40,000.

The Farmersville, Texas, County Commissioners court will advertise for bids for a 100 ft. iron bridge across the east fork of the Trinity, near Weston.

The county commissioners at Topeka, Kan., have called an election for July 26, to vote on issuing bonds to build a bridge across Kansas River on Kansas avenue.

County commissioners have decided to build an iron bridge over Raccoon Creek at Ladoga, Ind. The Rock Island Bridge Company of Canton, O., has the contract for $15,000.

The contract for the substructure for the Michigan street bridge, at Milwaukee, has been let to Brown & Hathaway, and for the superstructure to the Milwaukee Bridge Co., both contracts amounting to $45,000.

The Smith Iron and Bridge Co., Toledo, O., have the contract for the superstructure of the Cedar avenue bridge across the Minnesota in St. Paul, at $14,974. W. D. Van Norman received the contract for the substructure.

Charles A. Bortride, county auditor, Toledo, O., wants bids to July 21, for building a bridge and substructure thereto across Swan Creek, near state insane asylum, and also for a bridge across Ten Mile Creek in central Ohio.

The Gig Harbor Improvement Company has been organized by Samuel C. Hyde, of Spokane Falls, Sheriff Price, of Tacoma, and others, and will build a bridge over the Narros, between Tacoma and Gig Harbor.

Sewers.

A new outlet sewer is being agitated at Clifton, O.

At Port Huron, Mich., extensive sewers will be built.

A new main sewer is agitated at Atchison, Kansas.

New sewer districts will be established at Rockford, Illinois.

A $10,000 sewer may be built in Grand avenue, St. Joseph, Mo.

The Omaha, Neb., council has decided to build a sewer on 2d avenue.

F. E. Cole has been awarded contracts for several sewers at Toledo, Ohio.

Henderson, Kentucky, will probably issue $15,000 of bonds for sewers.

The Tyner, Tex., city council has contracted for a complete sewer system.

A contract has been let for a complete sewer system at North Yakima, Wash.

An ordinance has passed the Springfield, Ill., council for a sewer on Eighth street.

Montgomery, Ala., is considering the construction of a complete sewer system.

J. B. Leeny, of Chattanooga, Tenn., has been awarded a contract for sewer work, at $3,500.

Mobile, Ala., will employ Geo. S. Waring, jr., of Newport, to make plans for a sewer system.

Lincoln, Illinois, will commence work at once on the twelve mile, $40,000 special drainage ditch.

Ordinances have passed the Elkhart, Ind., council, for the construction of sundry brick sewers.

The Moline, Ill., council has passed an ordinance for the construction of an underground arch drain on 19th street, to cost $23,481, not including sewer.

The San Francisco, Cal., council has passed an ordinance for laying a ten-inch ironstone pipe sewer.

The St. Joseph Water Company will be required by the council to extend its mains on sundry streets.

The Council Bluffs, Ia., city clerk has been instructed to advertise for bids for a sewer on Second avenue.

The contract for constructing a sewer in district 19, at Little Rock, Ark., has been let to J. W. Lavender at $4,350.

Ordinances have passed the Appleton, Wis., council for the construction of a sewer on Union street and one on North street.

John S. O'Neil, J. C. F. Brandt, Jacob Werner and C. A. Sullivan have all been awarded extensive sewer contracts at Milwaukee.

The contract for the Fourteenth Street Pumping Station, at Chicago, has been let to Hanson & Wilkie, for mason and carpenter work, at $57,877, and to Biegler & Co., for cut stone work, at $38,222.

The board of public works at St. Paul has awarded contracts for the following sewers: In Phelan Creek Valley, between Minnehaha and Duchess streets, to Walter C. Doherty, at $69,000; Osceola avenue, and on Pleasant avenue, to Hanson & Johnson, at $3,303.33; Case street, to Patrick Doherty, $2,000.

The city of Aurora, Ill., has secured the services of Mr. Bennezete Williams, an expert civil engineer, who served for fifteen years as superintendent of the sewer system of Chicago, to examine and report upon the plans and specifications prepared by Chester B. Davis for a sewer system for that city—as also the changes made by City Engineer Dunning.

Street Lighting.

North Baltimore, O., will be lighted with electricity.

An electric light plant will be put in at St. Petersburg, Fla.

The Iowa City Fuel Gas Company has asked for a franchise.

At Ganzales, Texas, a company is being organized to erect an electric light plant.

The erection of a number of electric towers will be agitated at Dubuque, Iowa.

The Rushville, Ill., council is considering the putting in of an electric light plant.

The Waltham Watch Company will put in a complete electric light plant at Elgin, Illinois.

Greendale, O., has let a contract to the Thompson-Houston Company for the erection of an electric light plant.

The Walla Walla Electric Light and Gas Company have commenced the construction of their new power house.

Talledega, Ala., has granted a franchise to an electric light company of Richmond, Va., represented by J. A. Wright.

The Hamilton Electric Light and Power Company, of Hamilton, Wash., has been incorporated with a capital of $50,000.

O. H. Clarke, city recorder of Winona, Minn., wants bids till July 21st for lighting the streets of that city with electric, gas, or gasoline lights.

The Rapid City, S. D., city council has granted a franchise for a $75,000 gas-works plant to a Chicago company, represented by Hon. W. T. Coad.

The electric light company, of St. Paul, Minn., will use the Cobb Vulcanite Cable and the Dorsett Conduit in placing their wires underground. The work will cost $70,000.

The Suburban Electric Illuminating Heat and Power Company will probably be granted a franchise for erecting poles and lights within the city limits of Cincinnati, Ohio.

The Steubenville, O., city council will probably make a five years contract with the Steubenville Gas and Light Company to light the entire city with gas and electric lights.

The Seattle (Wash.) Electric Light Company has been reorganized with a capital of $500,000, and will build an additional plant. T. H. Tyndall, James A. McWilliams and J. H. McGraw are the directors.

The Hutchinson, Kan., city council on May 27, 1889, granted a franchise to R. R. Price for a system of electric lights and telephones. Work has not been begun on the same, and the council has just declared the franchise null and void.

The Missouri Electric Light and Power Company will erect additional boilers, engines and dynamos at St. Louis. The committee on city lighting of the Board of Public Improvements has also instructed Supervisor Matlack to order ninety-four additional arc lights.

Street Railways.

The Harney-West-Dodge Cable road at Omaha will be converted into a motor line.

Huron, S. D., has granted a franchise to Wm. T. Love for an electric street railway.

Maj. W. J. Kelly and others will build a new dummy line in South Pittsburg, Tenn.

The Sioux City, Ia., Street Railway Company has asked for a franchise on Douglas street.

The Sandusky, O., Street Railway Company will build a line to the Soldiers' Home.

Sam W. Miller, of Findlay, has asked for a franchise for a street railway at Sandusky, O.

Ogden & Andrews have a contract for building a Belt Street Railroad at Baton Rouge, La.

The Waco, Texas, Dummy Street Railway Company will ask for a franchise on 11th street.

City Engineer Prileau is surveying a route for an electric street railway at St. Augustine, Fla.

The Spokane Falls, Wash., City Park Transit Company has commenced the construction of its line.

The Duluth, Minn., Street Railway Company has commenced the construction of an $11,000 power house.

An Electric Street Railway Company will build a line on Central avenue, in Kearney, Neb., at once.

The Terre Haute, Ind., Street Railway Company contemplates putting in the overhead electric system.

The Astoria, Ore., Street Railway Company has been granted thirty days additional time to complete its line.

The Centralia, Wash., council has been asked for a franchise for an electric motor railway, by San Francisco capitalists.

The Seattle Electric Railway and Power Company has asked for a franchise for an additional line on South Third street.

Maria Mynster and others have asked for a franchise for the construction of a street railway on sundry streets in Council Bluffs, Ia.

The Manchester, Va., Railway Improvement Company contemplates ultimately equipping its line, now under construction, with electricity.

Greenville, S. C., has voted to grant a thirty-seven-years' franchise to a company of eastern capitalists who will build a $300,000 electric railway.

The franchise granted to Wm. C. Durant, Jas. J. Hurley and others, at Flint, Mich., has expired and no work having been done on the road, the franchise is forfeited.

The Cicero & Proviso Street Railroad Company has applied to the Public Works Department of Chicago for permission to lay tracks in that portion of the city, formerly a part of Cicero.

Public Parks.

Denver may lay out a new park.

At La Clair, Ill., a park will be laid out and streets improved.

A public park will probably be established at Brunswick, Ga.

Seattle, Wash., will vote on issuing bonds for the establishment of a large park.

A park will be established by Galena, Ill., at a cost of $3,000, to be known as Grant Park.

Capt. J. W. English and George Parrott, of Atlanta, will lay out a large park at Crawfish Springs.

A bill will probably pass the Mississippi legislature, granting permission to the city of Baton Rouge to establish a public park.

The citizens of Macon, Ga., are raising funds for converting the hillside, in front of Wesleyan College, into a park. The council will do the work.

Pipe Lines.

Savannah, Ga., will sink six artesian wells, and lay pipe, to cost $250,000.

The Excelsior Power and Heat Company have asked a franchise for laying pipes in the streets of Chicago for supplying steam and hot air. The Chicago Fuel Gas Company ask for similar privileges for piping natural gas from Indiana.

SEALED PROPOSALS.

SEWER EXTENSION.

Sealed proposals for the construction of sewer extensions and sewer appurtenances, and for furnishing material for the same in the City of Gloversville, N. Y., will be received at the office of the City Clerk, and shall be addressed to Chairman of Committee on Sewers and marked "Bids for Sewer Extensions."

No bids will be received after 6 P. M., July 21, 1890.

The work will comprise in general the following quantities:

10-inch vitrified pipe, about 1,050 feet.
8-inch vitrified pipe, about 7,290 feet.
6-inch vitrified pipe, about 1,750 feet.
4-inch vitrified pipe, about 4,800 feet.
Manholes, about 26.
Lamp holes, about 33.

Every proposal shall be signed by the bidder and accompanied by cash or a certified check to the amount of two hundred dollars ($200), made payable to the City Chamberlain of the City of Gloversville, N. Y., conditioned upon the execution of the required contract and required bond for the faithful performance of the terms of the contract in case of award.

The checks of unsuccessful bidders will be returned to them immediately after the contract is awarded, or all bids are rejected.

The Common Council reserves the right to reject any or all bids.

Copies of Specifications can be had on application to F. H. Wilmarth, City Clerk.

EUGENE MEAD,
Chairman Committee on Sewers.
F. E. ABBOTT, City Engineer.

PAVING, GRADING, WATER MAINS AND SEWERS.

Sealed proposals will be received by the City Clerk of Key West, Fla., until 1st of September, 1890, for furnishing the necessary material and putting in an underground system of sewerage; also for grading and paving the streets of said city and furnishing the material for same; also for furnishing and laying of water-mains.

1st. All bids must be made upon the printed forms to be obtained from the City Clerk and inclosed in a sealed envelope, directed to the Board of City Commissioners and marked on the outside of envelope, "Proposals for Key West Improvements."

2d. Each bid must be accompanied by a cash deposit or certified check of five hundred dollars, to be left in the hands of the City Clerk subject to the conditions specified, as a guarantee of the good faith of the bidder.

3d. The city reserves the right to reject any and all bids.

4th. Bidders are requested to be present at the opening of the bids.

5th. Bidders are expected to bid separately on sewer system and material, on grading and paving of streets and on furnishing and laying water-mains.

6th. Plans and specifications can be seen at the office of the City Clerk and at the office of Johnson & Flad, Consulting Engineers, Laclede Building, St. Louis, Mo.

WM. L. DELANEY, City Clerk.

WATER-WORKS.

Proposals for the erection of a system of water-works will be received by the undersigned until August 1, 1890. Plans can be seen on personal application. Specifications furnished if desired.

It is preferred that parties bidding make a personal examination.

The right to reject any or all bids is reserved.

F. R. VAN ANTWERP,
Prest. Hinton Water-Works Co.

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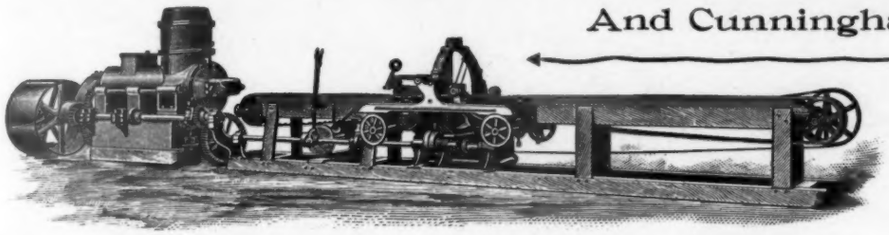

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Brick Street Contractors.

The City of Lexington, Kentucky, will let contracts for the construction of three miles of brick streets during the next twenty days, and invites correspondence and bids from brick street contractors who are equipped for pushing the work rapidly. Bond with security or a cash deposit must accompany bids. Plans and specifications will be furnished on application to J. M. Corbin, City Surveyor.

C. W. FOUSHE, MAYOR.

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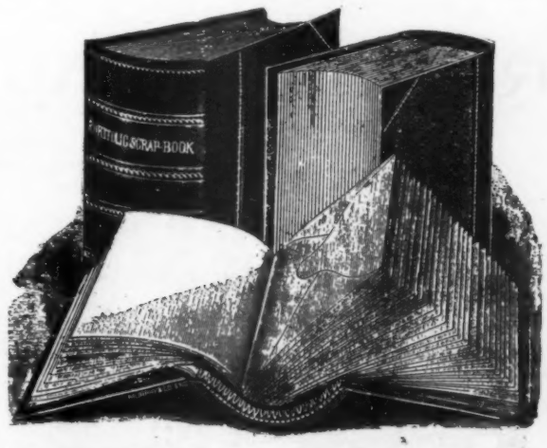

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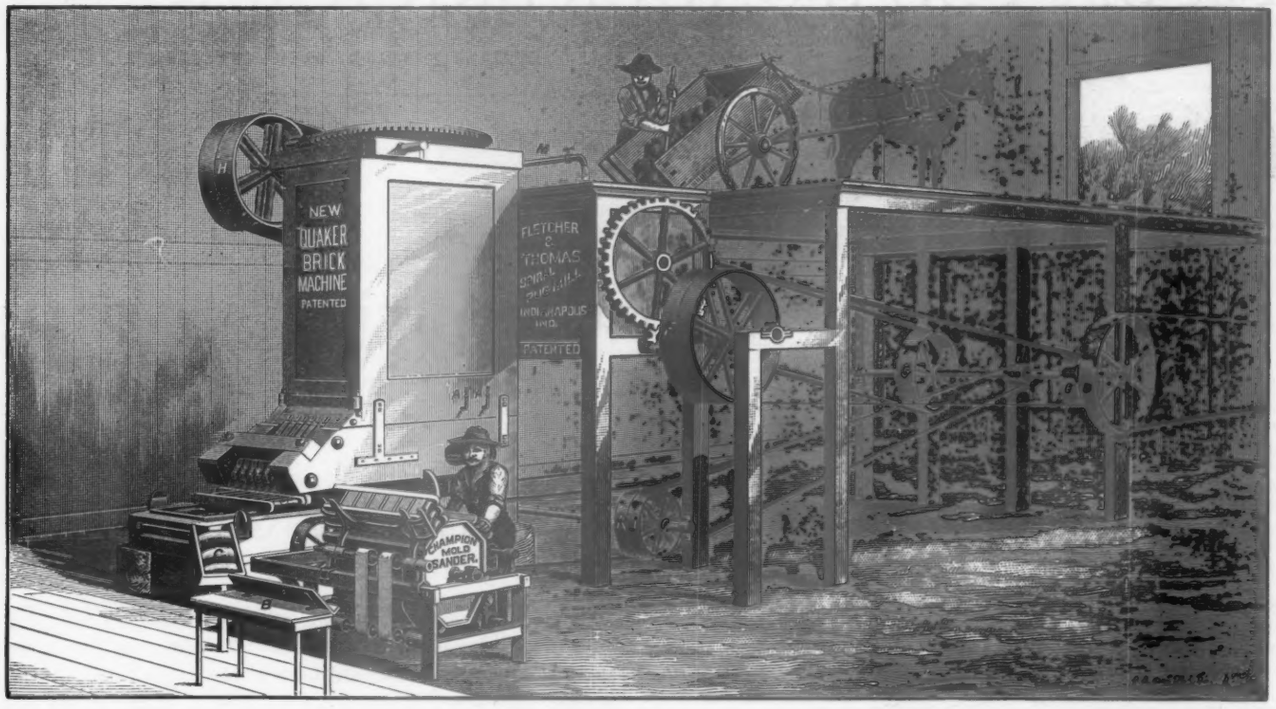

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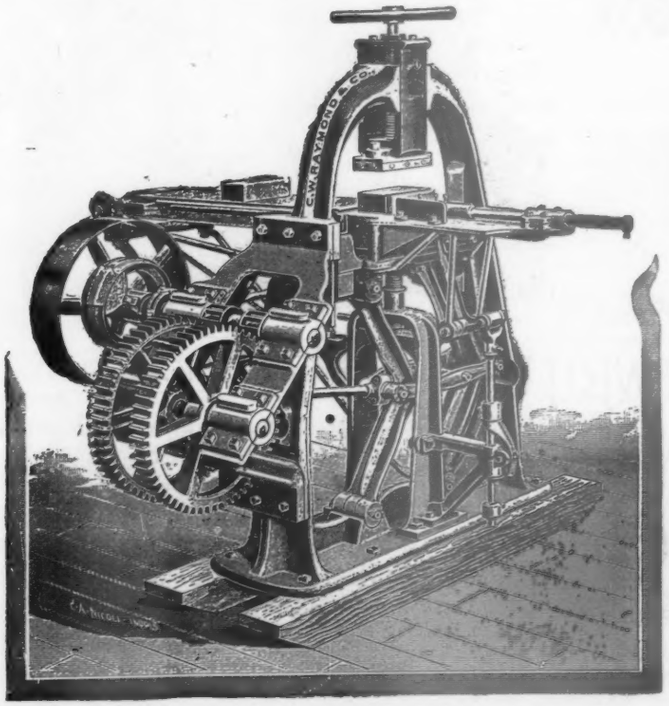

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